Where Will Our Power Come From?

By HARRY ZINK, E E II

NOT very long ago as far as the history of our country is concerned, man began to awaken to the potential sources of doing work that nature possessed. By means of various mechanical devices man began to use this power. The more power he used, the more he found out how to use. Now he is slowly beginning to realize that mother nature was not as generous with her products for doing work as he first thought. We will consider the problem with respect to the United States. It is rivaled only by Russia in natural resources, but already there are many who are sounding the warning of waning power resources.

By far, the most important fuel in America today is petroleum. About 1400 million barrels of it were used in 1941, and with the demands of war today, it is obvious that this consumption has greatly increased. It is known definitely that there are about twenty million barrels of oil that can be extracted from the ground. Assuming that the consumption of 1941 is continued, all of our now known petroleum will have been used in about fourteen years. Despite this figure, producers are not alarmed. They point to the greatly improved methods of drilling and prospecting and to the discoveries of new wells being made, and say there is nothing to worry about. Unfortunately, these discoveries of wells are not keeping up with the increasing demands. Because of this, the supply may not come up to the demand anticipated.

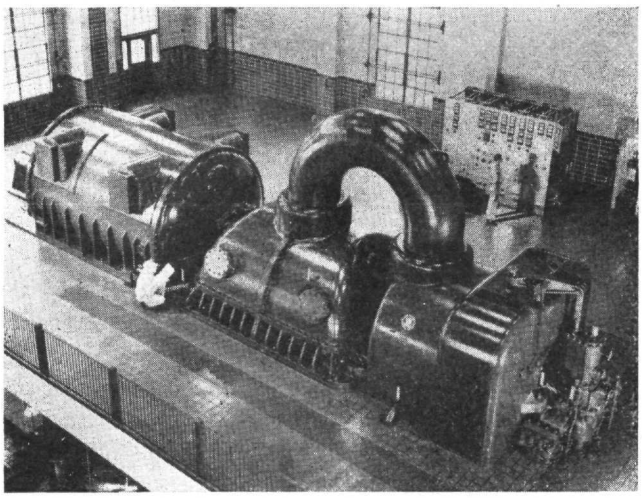
One may have heard the hypothesis that vast stores of oil are under the ocean or under the beaches along the Gulf of Mexico. There may also be oil at far greater depths than have yet been reached. This may be true, but it is difficult to extract the oil from all these places, and the user would bear the burden of the increased cost necessitated by deeper drilling. Even when the best possible methods of extraction are used, more than half the oil is still in the ground when the well has become unproductive. This is due to the adsorptive forces which hold the oil to the sand. Various methods of repressuring the sand by water and gas have been tried, but the small amount of oil obtained in this way does not make an appreciable increase to the total. The life of our oil wells will be greatly lengthened by the discovery of a cheap, effective method of breaking down these forces.

Another source of motor fuel might come from products obtained from coal. Benzol is obtained from the distillation of coal. In this process, the yield is about three gallons per ton of coal. It is satisfactory when blended with gases, but that produced by all the coke ovens in the world would supply only a small part of our needs. Hydrocarbons which are suitable for a liquid fuel can be obtained from coal by forcing the carbon in the coal to react, under pressure and with a suitable catalyst, with hydrogen. These methods may give a yield of 125 gallons per ton of coal processed. Before the war, Germany was manufacturing 200 million gallons of this type of fuel per year. This quantity would last a day and a half in the United States. These types of fuel would cost about 20 cents a gallon to produce as compared with the five or six cents a gallon for gasoline. Coal may run our cars, but we will have to pay for it.

Alcohol produced from farm products has been suggested as a motor fuel, but there has been much political bickering about it. Despite the marvelous claims of low cost, evidence seems to say that this fuel would cost from 15 to 20 cents a gallon. The amount of corn fields under cultivation cannot be increased without harm to the soil, and therefore the possibility of growing enough additional corn to use as alcohol for fuel seems remote. There is not enough sugar cane land in all the United States to meet our needs by alcohol from sugar. The production of alcohol from farm products is a slow process because the micro-organisms will not ferment the cellulosic waste directly in any great quantity. Research has shown recently that by properly controlled conditions this cellulosic material can be converted directly into hydrocarbons similar to petroleum which requires nature centuries to make. Up to the present, however, this is only a promise. From this brief survey of our petroleum needs and reserves, it may be seen that the days of almost free oil may soon be over and that it is not too soon to begin conservation.

Natural gas, at the present, is an important source of energy, but it suffers from the same handicaps that plague petroleum. It is possible that new reserves will be found and better methods of recovery developed. However, even if we are very lucky in these discoveries, our natural gas supply cannot last for much longer than a generation.

When coal is considered, the United States has



—*Courtesy Westinghouse.*

Electric energy constitutes only about 1/42 of the total mechanical and electric power consumed in the United States

the best supply in the world. We have 42 per cent of the world's coal and only six per cent of the world's population. Since coal mining was first started, only about 0.7 per cent of our coal has been used. When the present rate of consumption of coal is considered, we have enough bituminous coal to last for about 3000 years. However, above this pleasant aspect, there are a few facts to be considered. The better coal deposits where the coal is easy to obtain are rapidly being mined, and it will become increasingly difficult to obtain coal as the years go by. In all probability, it will never be possible to mine all the coal that is in the ground. Coal is localized, and other energy sources may better serve other areas. It can be seen then, that our coal supply may not last nearly as long as the survey would indicate.

There is a belief that water power might serve as a great source of energy through the generation of electric power. It is true that almost all of the electricity consumed could be generated by water power if it were properly placed. This statement is misleading, however, because only 1/42 of all the energy consumed is supplied by electricity. Because of this it is evident that we must look elsewhere for a major energy source.

So far all the sources of energy and power considered have been materials or effects that have obtained their energy from solar radiation. It has been proposed that we obtain our energy directly from the sun instead of waiting for nature to transform it for us by her inefficient methods. The amount of energy falling on the roof of a factory is enough to run every machine in the factory if it could be efficiently utilized. The energy falling on the Mojave Desert would in like manner supply the whole United States. But how can we capture this energy? That is the problem that has been puzzling scientists for years.

The photo-electric cell provides one method of utilizing the sun's rays, but it operates at about 1.5 per cent efficiency and is very expensive. If radical improvements are made in them and the cost of production is lowered sharply, they might then be workable, but at the present, the outlook is discouraging. The obvious method of heating water to make steam by focusing the sun's rays has been experimented with for a long time, and many impractical devices for doing this have been patented. The best efficiency developed thus far has been 15 per cent. If this method is to be used for mechanical work, the efficiencies will have to be much higher, a seemingly impossible goal as long as steam is used in its operation. Solar boilers might be used to heat buildings if a good low-boiling liquid could be found that would retain heat for a long period.

The first source of all our fuels is the chemical reaction of photosynthesis by which solar energy aids carbon dioxide and water, in the presence of chlorophyll, in combining to form formaldehyde and then more complex compounds. This solar energy which was used in this combination can be recovered in part by the oxidation of the compounds. In performing photosynthesis, nature is only about two per cent efficient. If chemists could employ their cleverness in catalytic reactions and greatly increase this efficiency, we would have an excellent way of storing energy. This

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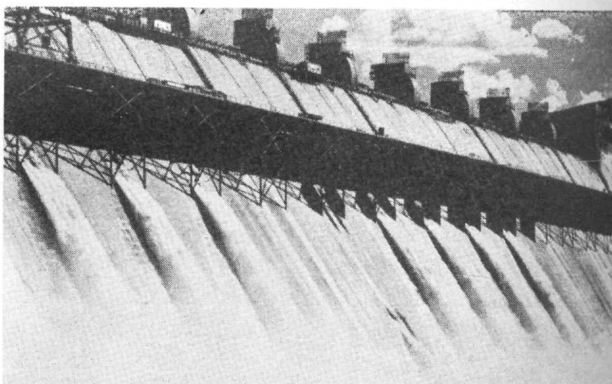

—*Courtesy Westinghouse.*

Hydroelectric energy represents about 30 percent of the total electric enery generated in the United States

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energy could then be used by oxidizing it in the presence of some type electrochemical cell which would convert the stored energy into electrical energy. This field of photosynthesis is underdeveloped and presents great possibilities. Some day this approach will either be solved or proved completely unworkable.

Where does the sun get its energy? When we attempt to answer that question, we come upon the most original but perhaps the most basic source of energy. Einstein's considerations tell us that mass can be converted into energy. The fundamental relation is expressed by the equation

$$\text{energy} = \text{mass} \times \text{constant}$$

where the constant is the speed of light. From this it is seen that if we could completely annihilate coal, we could get 3000 million times more energy than we could by burning it. It has been found that the sun gets its energy from the transmutation of hydrogen to helium with the liberation of great quantities of energy. The development of such a device on the earth seems far in the future, but there are men continually working to discover more about this method of producing energy. Radium is an example of this type of energy production, but it is too rare and the disintegration is too slow to be of any practical value.

The greatest promise for the conversion of mass into energy on a practical scale lies in uranium-235. In uranium, 0.79 per cent is uranium-235. When uranium-235 is bombarded with slow velocity neutrons, it actually splits in two and releases many high velocity neutrons which carry the energy that was given off by this reaction. If some of these neutrons could be slowed down enough to split other uranium atoms, a tremendous amount of energy could be obtained. The chief problem this far is that it is very difficult to separate this small amount of uranium-235 from the uranium. Because of this, not enough uranium has been obtained to perform this experiment on a large scale. The well-informed scientists realize that the chances of success with this method are very small, although there is some hope that it can be developed. If it is successful, it will make other searches for energy like child's play.

After looking over the possibilities for power sources in the future, we can see the great amount of work which lies ahead in the supplying of adequate power to our nation. It is important, therefore, that we not only see the danger of our ever decreasing power sources but also that we be prepared to do something about it.